REPLACED BY ART 34 AMDT

CLAIMS:

1. A method for use in recording/reading data from an array of data units within a three-dimensional storage medium, the method comprising:

(a) providing exciting radiation in the form of first and second light beams of first and second different wavelengths, respectively;

(b) concurrently directing said first and second light beams and focusing them onto desirably distanced from each other sites in the medium, and collecting excited light of a third wavelength coming from the excited site in the medium to form a third excited light beam and direct it towards a detector assembly, while correcting for chromatic and spherical aberrations of the light focusing and collection,;

(c) sequentially repeating step (ii) for successive sites in the medium with varying depth of focus.

2. The method of Claim 1, wherein said focusing and collecting include passing the exciting light beams and the excited light through the same focusing/collecting arrangement.

3. The method of Claim 2, wherein the geometry of said focusing/collecting arrangement and its accommodation relative to the medium and to light source and detector assemblies are optimized to be capable of focusing each of the exciting light beams to said desirably distanced from each other sites and collecting the excited light from the excited site in the medium.

4. The method of Claims 2 or 3, wherein said focusing/collecting arrangement comprises two lens assemblies accommodated in an optical path of the exciting and excited light beams being arranged in a spaced-apart relationship along an optical axis of the focusing/collecting arrangement, one of said two lens assemblies being designed to perform the majority of light bending required for the focusing of the exciting light and collecting the excited light, and the other of said two lens assemblies being designed to compensate for changing spherical aberration

introduced by a change in a thickness of the medium into which the exciting light is being focused.

5. The method of Claim 4, wherein said lenses of the focusing/collecting arrangement have different surface geometries, at least one of these surfaces being aspheric.

6. The method of Claim 4 or 5, wherein that one of the two lens assemblies which is designed to compensate for changing spherical aberration is located closer to the medium.

7. The method of Claim 6, wherein each of said two lens assemblies comprises a single lens.

8. The method of Claim 6, wherein that one of the two lens assemblies which is designed to perform the majority of light bending is configured to define two lens portions of different materials and geometries.

9. The method of Claim 8, wherein said lens portions are separate lens elements arranged in a spaced-apart relationship along the optical axis with a gap between them.

10. The method of Claim 8, wherein said lens portions are separate lens elements arranged in a spaced-apart relationship along the optical axis and are attached to each other.

11. The method of any one of Claims 6 to 10, wherein said lens located closer to the medium is a flying lens.

12. The method of Claim 4 or 5, wherein that one of the two lens assemblies which is designed to perform the majority of light bending is located closer to the medium, the other one of the two lens assemblies being a multiple-lens assembly.

13. The method of any one of Claims 4 to 12, wherein the varying of the depth of focus comprises displacing at least one of the lenses of the focusing/collecting arrangement with respect to at least one other lens thereof along an optical axis defined by the focusing/collecting arrangement.

14. The method of Claim 13, comprising displacing the focusing/collecting arrangement with respect to the medium.

15. The method of any one of Claims 1 to 14, wherein the varying of the depth of focus comprises varying the optical path lengths of the exciting light beams and the optical path of the excited light while propagating towards and away from the medium. respectively.

16. The method of Claim 15, comprising displacing light sources, detector and focusing/collecting arrangement with respect to the medium.

17. The method of Claim 15 or 16, comprising displacing the medium with respect to the focusing/collecting arrangement.

18. The method of any one of Claims 2 to 17, wherein the correction of chromatic aberrations is carried out by pre-shaping of the exciting beams so as to provide arrival of each of the excited beams to the focusing/collecting arrangement with a desired degree of the beam divergence/convergence, and by post-shaping of the excited beam so as to provide the excited beam arrival at a detector assembly with a desired degree of the excited beam divergence/convergence, while correction of spherical aberration is carried out substantially by the focusing/collecting arrangement.

19. The method of Claim 18, wherein said pre-shaping comprises providing a small degree of divergence/convergence of each of the first and second exciting light beams' arriving at the focusing/collecting arrangement, thereby providing semi-infinite conjugation of the first and second beams.

20. The method of Claim 18, wherein said pre-shaping comprises providing a large degree of divergence/convergence of each of the first and second exciting light beams when arriving at the focusing/collecting arrangement, so as to provide finite conjugation of the first and second exciting light beams.

21. The method of Claim 19 or 20, comprising passing each of the first and second exciting light beams through a lens assembly appropriately designed and oriented with respect to a corresponding light source to provide the desired degree of the beam divergence/convergence.

22. The method of Claim 19 or 20, comprising accommodating the focusing/collecting arrangement at certain distances from the first and second light

sources, generating said first and second light beams, to provide the desired degree of divergence/convergence of each of the first and second light beams when arriving at the focusing/collecting arrangement.

23. The method of Claim 18, wherein said pre-shaping comprises collimating one of the first and second exciting light beams and providing a small degree of divergence/convergence of the other of said first and second exciting beams when arriving at the focusing/collecting arrangement so as to provide semi-infinite conjugation of said other beam.

24. The method of Claim 18, wherein said pre-shaping comprises collimating each of said first and second exciting light beams, while propagating towards the focusing/collecting arrangement.

25. The method of any one of Claims 4 to 24, wherein that one of the two lens assemblies of the focusing/collecting arrangement that is located closer to the medium is kept at a constant distance from the medium, and at least one other lens of the focusing/collecting arrangement is movable along the optical axis.

26. The method of any one of Claims 12 to 25, wherein said multiple-lens assembly comprises three lenses arranged in a spaced-apart relation along the optical axis.

27. The method of Claim 26, wherein said varying of the depth of focus comprises moving an intermediate one of said three lenses along the optical axis.

28. The method of any one of preceding Claims, wherein said first and second exciting beams are respectively reading and recording light beams.

29. The method of any one of Claims 1 to 27, wherein said first and second exciting beams are reading light beams.

30. The method of any one of Claims 1 to 27, wherein said first and second exciting beams are recording light beams.

31. An optical system for use in recording/reading data from an array of data units within a three-dimensional storage medium, the system comprising:

(a) a light source assembly operable to produce exciting radiation in the form of first and second light beams of first and second different wavelengths,

REPLACED BY ART 34 AMDT

respectively, thereby enabling excitation of desirably distant from each other sites in the medium to produce excited light of a third wavelength;

(b) a detector assembly for receiving the excited light and generating data indicative thereof;

(c) a focusing/collecting assembly accommodated in the optical path of propagation of said exciting and excited light, a geometry of said focusing/collecting arrangement and its accommodation relative to the medium and to the light source and detector assemblies being optimized to enable directing the exciting light beams and focusing them onto said sites and enable collecting the excited light to form an excited light beam to propagate towards the detector assembly, while correcting for chromatic and spherical aberrations of focusing; and

(d) a drive means associated at least with the focusing/collecting arrangement to move at least one of lenses of the focusing/collecting arrangement along an optical axis of the focusing/collecting arrangement to thereby effect variation of a depth of focus, while the exciting radiation is applied to successive sites in the medium during a relative displacement between the system and the medium.

32. The system of Claim 31, comprising a beam shaping assembly accommodated in the optical paths of the first and second exciting beams and operating to pre-shape each of these beams to arrive at the focusing/collecting arrangement with desired degree of divergence/convergence, and to post-shape the collected excited light beam while propagating towards the detector.

33. The system of Claim 32, wherein said focusing/collecting arrangement comprises two lens assemblies accommodated in an optical path of the exciting and excited light beams and being arranged in a spaced-apart relationship along the optical axis of the focusing/collecting arrangement, one of said two lens assemblies being designed to perform the majority of light bending required for the focusing of the exciting light and collecting the excited light, and the other of said two lens assemblies being designed to compensate for changing spherical aberration

REPLACED BY ART 34 AMDT

introduced by a change in a thickness of the medium into which the exciting light is being focused.

34. The system of Claim 33, wherein the lenses of the focusing/collecting arrangement have different surface geometries, at least one of these surfaces being aspheric.

35. The system of Claim 33 or 34, wherein that one of the two lens assemblies which is designed to compensate for changing spherical aberration is located closer to the medium.

36. The system of Claim 35, wherein each of said two lens assemblies comprises a single lens.

37. The system of Claim 35, wherein that one of the two lens assemblies which is designed to perform the majority of light bending is configured to define two lens portions of different materials and geometries.

38. The system of Claim 37, wherein said lens portions are separate lens elements arranged in a spaced-apart relationship along the optical axis with a gap between them.

39. The system of Claim 37, wherein said lens portions are separate lens elements arranged in a spaced-apart relationship along the optical axis being attached to each other.

40. The system of any one of Claims 35 to 39, wherein said lens located closer to the medium is a flying lens.

41. The system of Claim 33, wherein that one of the two lens assemblies which is designed to perform the majority of light bending is located closer to the medium, the other one of the two lens assemblies being a multiple-lens assembly.

42. The system of Claim 41, wherein said multiple-lens assembly comprises three lenses arranged in a spaced-apart relation along the optical axis

43. The system of any one of Claims 33 to 42, wherein said drive means operates to displace that one of the two lens assemblies, which is designed to compensate for changing spherical aberration, along the optical axis.

44. The system of any one of Claim 33 to 43, wherein said drive means operates to move each of the two lens assemblies of the focusing/collecting arrangement along the optical axis.

45. The system of any one of Claims 32 to 44, wherein said beam shaping assembly comprises a lens assembly designed to provide a small degree of divergence/convergence of each of the first and second exciting light beams when arriving at the focusing/collecting arrangement to provide semi-infinite conjugation of each of said beams.

46. The system of any one of Claims 32 to 44, wherein said beam shaping assembly comprises a lens assembly designed to provide collimation of one of the first and second light beams and a small degree of divergence/convergence of the other of said first and second exciting beams when arriving at the focusing/collecting arrangement to thereby provide a semi-infinite conjugation of said other beam.

47. The system of any one of Claims 32 to 44, wherein said beam shaping assembly comprises collimating lenses in the optical paths of the first and second light beams, respectively, propagating towards the focusing/collecting arrangement.

48. The system of any one of Claims 32 to 44, wherein said beam shaping assembly comprises a lens assembly designed to provide a large degree of divergence/convergence of each of the first and second exciting light beams when arriving at the focusing/collecting arrangement to thereby provide finite conjugation of each of the first and second light beams.

49. The system of any one of Claims 31 to 48, comprising a lens assembly in the optical path of the first and second exciting beams generated by the light sources to affect the beams to provide substantially circular cross-section thereof.